Citation:

Flood JE, Rolls BJ. Soup preloads in a variety of forms reduce meal energy intake. Appetite. 2007 Nov;49(3):626-34. Epub 2007 Apr 14.

PubMed ID: 17574705

Study Design:

Randomized Crossover Trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the effects of consuming different forms of a low-energy-dense soup on subsequent test meal intake and total energy intake at the meal (soup preload plus test meal).

Inclusion Criteria:

- Age between 18-45 years
- Not taking medications that are known to affect appetite or food intake
- non-smokers
- regularly consume three meals a day
- Not dieting to gain or lose weight
- Not athletes in training
- Not pregnant or breastfeeding
- Free from food allergies and food restrictions
- BMI between 18-40 kg/m^2
- Score less than 40 on the Zung Questionnaire which measures depression
- Score less than 20 on the Eating Attitudes Test (EAT-26)

Exclusion Criteria:

- Consumption of entire entrée on more than one occasion, otherwise, excluded if not included above

Description of Study Protocol:

Recruitment : Subjects were recruited from a university community by informational flyers, electronic mailing lists, and newspaper advertisements.

Design: Randomized Crossover Trial

Blinding used (if applicable): no (participants and researchers could identify type of soup consumed)

Intervention (if applicable):

- Soup preload -All soups preload contained the same ingredients; broth, vegetables, and butter,and the same energy density (1.4 kJ/g) but each was prepared using a different method. They were:chicken broth and vegetable soup; chunky soup; chunky-pureed soup blended with half of the vegetables and pureed soup blended with all vegetables. The women had 350 ml of soup and men 475 ml. The viscosity of each soup was measured using an ARES-RFS rheometer. On the test days a standard breakfast was consumed *ad libitum* and lunch was scheduled at least 3 hours after breakfast. Subjects completed a food and activity diary the day before each test session to encourage compliance with the protocol. They also were told to keep the amount of food eaten and physical activity performed the day before coming the test as consistent as possible across sessions. At the beginning of each lunch meal, subjects were served one of four vegetabale soup preloads or no preload. They were required to consume the entire preload (soup) within a period of 12 minutes. The test meal was served 15 minutes after the preload was served. For the Test meal subjects could eat or drink *ad libitum*. The amount of time taken to consume the test meal was recorded for each subject.
- Test meal provided for each condition consisted of cheese tortellini (460 g for females, 612 for males), tomato sauce and parmesan cheese. It contained 64% of energy from carbohydrate, 16% of energy from fat and 20% of energy from protein and 2.6 kcal/g. Portions were based on lunch intake data from previous studies from the same laboratory

Statistical Analysis:

- Power analysis for sample size of 53 subjects would allow the detection of a 45 kcal difference in meal energy intake at a significance level of 0.05 and a power of 80%
- Mixed linear model with repeated measures
- Analysis of covariance
- A difference with $P<0.05$ was considered to be significant

Data Collection Summary:

Timing of Measurements:

- Eating inventory, Zung Questionnaire and Eating Attitudes test plus weight and height were measured at baseline.
- Food and activity diary were assessed the day before each test session, every week, during five weeks of the protocol.
- A report to evaluate compliance, 100-mm visual analog scales that assessed ratings of hunger, satiety, and food characteristics were performed once a week during five weeks.
- The amount of time taken to consume the test meal was recorded every time during the five weeks study.

Dependent Variables

- Food intake and Energy intake - All foods and beverages were weighed prior to being served to subjects and after they ate. Energy intakes were calculated using nutrition information provided by the food manufacturers
- Ratings of hunger, satiety, and food characteristics - In each test day a series of 100-mm visual analog scales to assess hunger, thirst, fulllness, prospective consumption and nausea were giving to the participants before and after breakfast, before and after the preload time period, and after lunch. They also rated the characteristics of the soup preload and the lunch test meal as well as perceived calorie content and portion size of the test meal

Independent Variables

- Soup preload vs no preload

Control Variables

- subject sex
- awareness of the purposes of the study

Description of Actual Data Sample:

Initial N: 73 (38M;35F)

Attrition (final N): 60 (30M;30F)

Reasons for dropouts: consumed entire test meal on more than one occasion (6); non-compliance with study protocol or inability to attend scheduled meals (7)

Age: mean age of 26 years (range from 20-46)

Ethnicity: not reported

Other relevant demographics:

Anthropometrics: The men weighed more and they were taller than women. However, there was no difference in the BMI between women (24.1$\pm$0.3 kg/m^2) and men (23.9$\pm$0.3kg/m^2)

Location:Pennsylvania State University, PA

Summary of Results:

Key Findings

- Subjects reduced total energy intake at lunch by 20% (134$\pm$25 kcal) when a soup preload was eaten compared to when no soup was eaten; P<0.0001
- Mean total meal energy density was lower when a soup preload was consumed (1.0 kcal/g), compared to when no soup was consumed (2.2 kcal/g)
- Subjects consumed a significantly greater total weight of food at the meal when soup (broth and vegetables; chunky soup; chunky-pureed soup; pureed soup) was consumed compared to when the meal was consumed without soup; 774$\pm$26 g; 752$\pm$24 g;759$\pm$24 g;751$\pm$24 g vs 417$\pm$22 g; P<0.0001; respectively
- The different types of soup had no signficant effect on intake of the test meal or total energy

intake
- Ratings of hunger before the lunch test meal was served (36±1) were significantly lower when soup had been eaten as a preload, compared to when subjects did not consume soup (65±2); P<0.001
- Fullness ratings were significantly higher before the lunch test meal was served when a soup preload was eaten compared to the no soup preload ;56±1 and 26±3; P=0.04, respectively.

Other Findings

- Dietary restraint score, disinhibition and perceived hunger scores were lower in males compared to females; P<0.01 at baseline
- Taste ratings were significantly higher for the chunky and chunky-pureed soup compared to the broth and vegetables; P<0.004
- The ratings of calorie content for chunck-pureed and pureed soups were significantly higher than those for broth and vegetables and chuncky soup; P<0.01
- The relationship between type of preload and energy intake at lunch was not influenced by any of the soup characteristic ratings
- On the discharge questionnaire sixty-three percent of subjects correctly reported that the purpose of the study was to examine the effects of soup on food intake, and most of them (88%) noticed that the type of soup served changed between sessions.

Author Conclusion:

Consuming a preload of low-energy-dense soup, in a variety of forms, is one strategy for moderating energy intake in adults.

Reviewer Comments:

- *The outcomes may be restricted to a healthy and not obese population*
- *Subjects who had high intake of food were excluded from the sample which may increase sampling bias*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes

4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	No
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	No
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	No
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes

7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	No
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes